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More About Soils

Soil color can be an important indicator of conditions that will affect the performance of an onsite treatment system

By Jim Anderson, Ph.D., and David Gustafson, P.E.

As promised last month, and after numerous soil-related questions, we will discuss soil color which we consider to be the second most important property for installers to recognize.

Color is an important soil property because a number of other soil characteristics can be determined from it. You can use color to estimate the organic matter content in the soil. Color can be the indicator that the soil was formed under certain vegetation types or has undergone human disturbance. Many soils exhibit color inherited from the parent material from which the soil formed. All this can provide information that is important to the location and operation of a soil treatment system.

Soil horizons may contain many colors. These changes should be identified on the soil boring logs or pit descriptions provided as part of the design information. You should review this information and compare with what you see when excavating the system.

Humus and iron

There are two primary coloring agents in the soil: humus (organic matter) and iron. Most people recognize the dark color at the surface as being due to the presence of organic matter from decaying vegetation. In humid areas, this surface layer can be very dark and thickened. In arid regions where organic matter content is low for lack of vegetation and high oxidation rates of organic matter, the color change or variation can be very slight. So, interpreting color requires you to recognize the different locations you are working in.

The varying shades of red, yellow, or gray found in soils usually reflect the quantity and form of iron present. Uniformly red or brownish colors indicate that the iron is in an oxidized form and is not hydrated. Yellow can indicate somewhat less oxidation and some hydration. Gray indicates a chemical reduction of the iron from wetness and lack of oxygen. Thus, soil color is an indicator of natural soil drainage conditions.

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Clumps of soil seen in close-up reveal redoximorphic features used to determine seasonal soil saturation. (Photos by Dave Gustafson)

Limiting conditions

The apparent color changes come from the native parent material, or the soil-forming processes. These processes result in the movement or translocation of clay, organic matter, and silt in the profile. One process that needs special attention is using color to estimate the presence of seasonally saturated soil conditions.

These color conditions become the depth of limiting conditions and will determine the depth or type of system that can be installed. Soil redoximorphic features (mottling) indicate the presence of saturated soil. Most state codes require use of these features to determine the seasonal high water table.

System separation distances are determined from the point of first identification of these features in the profile. One reason for using these features is that soil color can indicate the presence of saturated conditions even if the soil is dry at the time of site evaluation.

These features form in saturated soil by the processes of reduction, translocation, and oxidation of iron and manganese compounds. In saturated soil above 41 degrees F, soil bacteria deplete the oxygen they need to digest organic matter. Anaerobic bacteria use oxygen from the iron and manganese compounds, making them water soluble. These

A Munsell Color Book is the most common tool for identifying soil color.

Soil Science instructor Dan Wheeler of the University of Minnesota points out color features in a soil test pit.

soluble compounds move with the water until they reach an oxygen-rich zone.

Once they encounter oxygen, the compounds precipitate, accumulating as coatings of reddish or yellowish iron oxide or black manganese oxide on the faces of the soil structure units, on the walls of pores or cracks, or on the inside of the soil beds. The area from which the iron and manganese oxides are removed becomes light gray. The areas where the iron accumulates are reddish or yellowish, giving the soil a distinct mottled or blotchy appearance.

In depressions, or in soils that are waterlogged for extensive periods, the soils have not been flushed of the dissolved iron oxide. This results in a bluish gray or greenish color. This color will change when the soil is left exposed to the air and the iron becomes oxidized. This indicates that this soil is saturated for long periods, whether or not you see free water in the hole.

Take precautions

It is important to recognize these conditions. First, when excavating for the tank, you need to recognize the presence of water table so you can take proper precautions to prevent the tank from floating if it happens to be pumped dry during a wet period.

Second, you need to recognize if the bottom of the trench excavation meets the required separation distance from the limiting soil saturation. This is important to ensure adequate treatment of the septic tank effluent. Remember that saturated soils mean a lack of oxygen. Since we rely on the aerobic (oxygen-loving) bacteria for treatment, there will be less treatment in oxygen-poor soil.

There is also the physical limitation of the soil being unable to accept more water. Think of trying to put more coffee into an already full cup. Third, soil conditions may change along a hill slope, and you may encounter natural drainage paths. If you excavate trenches without paying attention to color changes, the trenches can intercept this natural drainage water. At that point, the trenches become a drainage system for that water, which most likely will overload the system and cause failure. That can mean an expensive re-installation.

Standard tool

There is a standard nomenclature for describing soil color called the Munsell soil color notation. We teach about how to read soil color in our soils classes. If you are not doing site evaluation or design work, it is not absolutely necessary to know the notation, but it helps to be able to recognize the conditions.

You should see the notation on the site evaluation reports and the design. If color is not a part of the evaluation, you should check with the evaluator or designer to see why not, particularly if you see colors that might indicate the presence of saturated soil. We will address the Munsell notation and other soil characteristics in future articles. ■

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